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THE UNITED STATES OF AMERICA

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UNITED STATES DEPARTMENT OF COMMERCE

United States Patent and Trademark Office

June 25, 2004

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK OFFICE OF THOSE PAPERS OF THE BELOW IDENTIFIED PATENT APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A FILING DATE UNDER 35 USC 111.

APPLICATION NUMBER: ***60/484,678***
FILING DATE: ***July 07, 2003***

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COVER SHEET FOR FILING U.S. PROVISIONAL APPLICATION UNDER 37 CFR 1.53(c)

Commissioner of Patents and Trademarks
Arlington, Virginia 22313-1450

Re: New U.S. Provisional Patent Application
For: **APPARATUS AND METHOD FOR SEALING VESSELS**
Inventors: Yuri LIFSHIZ; Rishon Lezion, ISRAEL
Attorney Docket: 25557

Sir:

Attached hereto is the application identified above, including:

10 Pages Application Consisting of:
6 Pages of Textual Specification
1 Page of 2 claims
0 Pages containing the Abstract of the Disclosure
3 Pages of Drawings
__ Executed Inventor's Declaration

The present provisional application names the following inventor(s): 1) Yuri LIFSHIZ; Rishon Lezion, ISRAEL

The Government filing fee* is calculated as follows:
Base Fee (Provisional Application) . . . . . $ 80.00

TOTAL FILING FEE*
(accounting for possible small entity status) . . . $ 80.00

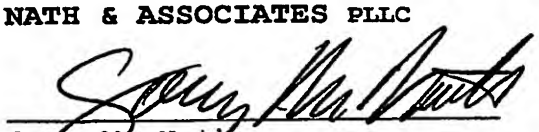
__X__ *Reduced by one-half, as applicant(s) is/are a "small entity".

__3__ Sheets of Drawing(s) is/are attached.

__X__ Submitted herewith is a check in the amount of $ 80.00. The Commissioner is hereby authorized to charge any deficiency or credit any excess to Deposit Account No. 14-0112.

Respectfully submitted,

NATH & ASSOCIATES PLLC



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GMN/MCB/ls (ProvisionalAppl.coversheet)

MAIL STOP PROVISIONAL PATENT APPLICATION
Attorney Docket No. 25557

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

LIVSHIZ

Serial No. Not yet assigned

Filed: July 7, 2003

For: **APPARATUS AND METHOD FOR SEALING VESSELS (PROVISIONAL APPLICATION)**

TRANSMITTAL LETTER

The Commissioner for Patents
Alexandria, Virginia 22313-1450

Sir:

Submitted herewith for filing in the U.S. Patent and Trademark Office is the following **PROVISIONAL APPLICATION:**

(1) Transmittal Letter
(2) Cover sheet for filing Provisional Application
(3) 10 page Provisional Application consisting of:
- 6 pages Textual Specification
- 1 page of 2 claims
- 0 pages containing the Abstract of the Disclosure
- 3 sheets of drawings

(4) Check No. 18901 $ 80.00 for filing fee
(5) Postcard for early notification of serial number.

The Commissioner is hereby authorized to charge any deficiency or credit any excess to Deposit Account No. 14-0112.

Respectfully submitted,
NATH & ASSOCIATES PLLC

By: _____

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PATENT APPLICATION SERIAL NO. _____

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE
FEE RECORD SHEET

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PTO-1556
(5/87)

*U.S. Government Printing Office: 2002 — 489-267/69033

Apparatus and method for sealing vessels

FIELD OF THE INVENTION

This invention relates to a method and apparatus for sealing containers, and in particular, for sealing containers by a pulse magnetic force (PMF).

BACKGROUND OF THE INVENTION

A vessel such as a container, canister, tank, flask, etc. used, for example, for gas and/or liquid storage is usually produced by manufacturing a vessel body portion and a cover portion separately. For sealing the vessel, welding or crimping methods can be used for coupling the cover portion to the vessel body portion. The welding is usually carried out by a gas welding apparatus, laser or any other conventional welding technique. The crimping is usually made by stamping or rolling.

It should be noted that the aforementioned conventional techniques suffer from different disadvantages, e.g., the vessel body must be made of a heatproof material, etc.

It is known that pulse magnetic welding and /or forming techniques (see, for example U.S. Pat. No. 5,824,998 to the Assignee of this application) can overcome some of the problems of conventional welding or crimping methods.

SUMMARY OF THE INVENTION

According to one broad aspect of the present invention, there is provided a method of sealing a vessel comprising:

- providing a vessel body portion having an open end;

- providing a cover portion;
- placing the cover portion into said open end of the vessel portion so that an annular gap is provided between said vessel body portion and an edge of said cover portion;
- providing an induction coil around said open end of said vessel body portion and over the edge of the cover portion; and
- energizing the coil to generate the magnetic pulse force for collapsing the end of the vessel body portion around the cover portion at a velocity sufficient for said magnetic pulse force to weld said vessel body portion and the cover portion along the edge to each other.

According to another broad aspect of the present invention, there is provided an apparatus for sealing a vessel comprising an induction coil configured for surrounding an open end of a vessel body portion, where said vessel body portion holds a cover portion being placed into said open end of the vessel so that an annular gap is provided between said vessel body portion and the cover portion.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to understand the invention and to see how it may be carried out in practice, a preferred embodiment will now be described, by way of non-limiting example only, with reference to the accompanying drawings, in which:

Fig. 1 is a cross-sectional view of a vessel including a vessel body portion and a cover portion before a sealing process, according to one embodiment of the invention;

Fig. 2 is a cross-sectional view of the vessel body portion before a sealing process, according to another embodiment of the invention;

Fig. 3 is a cross-sectional view of the vessel body portion before a sealing process, according to yet another embodiment of the invention.

Fig. 4 is a cross-sectional view of the vessel of Fig. 1 surrounded by an induction coil, according to one embodiment of the present invention;

Fig. 5 is a cross-sectional view of an example of an induction coil of the present invention; and

Fig. 6 is a cross-sectional view of the vessel of Fig. 1 surrounded by an induction coil, according to another embodiment of the present invention;

DETAILED DESCRIPTION OF THE INVENTION

The principles and operation of a method and an apparatus according to the present invention may be better understood with reference to the drawings and the accompanying description, it being understood that these drawings are given for illustrative purposes only and are not meant to be limiting. The same reference numerals will be utilized for identifying those components which are common in the vessel and the working coil shown in the drawings throughout the present description of the invention.

Fig. 1 illustrates a cross-sectional view of a vessel 10 before a sealing process. The vessel 10 includes a vessel body portion 1 having an open end 11 and a cover portion 2. The cover portion 2 is placed into the open end 11 of the vessel portion 1 so that an annular gap 12 is provided between the vessel body portion 1 and an edge 13 of the cover portion 2.

Examples of the materials from which the vessel body portion 1 and the cover portion 2 are made include, but are not limited to, aluminum, low carbon steel, brass, copper. It should be appreciated that alloys of these and other materials can also be used.

In order to fix the cover portion 2 within the vessel body portion before the sealing process, according to this embodiment, an additional technological cover (21 in Fig. 4) can be used together with the cover portion 2. This additional technological cover (21 in Fig. 4) can be connected to the cover portion 2 by attaching means. An example of the attaching means includes, but is not limited to, pins (22 in Fig. 4) placed in holes (not shown) specially arranged in the cover

portion 2. The additional cover can, for example, be made of an insulating material, e.g., plastic.

According to another embodiment of the invention, in order to fix the cover portion within the vessel body portion before the sealing process, the vessel body portion has an expanded zone A at the open end (see **Fig. 2**). The diameter D_A of the vessel body portion at the expanded zone A has a value larger than the diameter D_V at the remaining portion of the vessel. According to this embodiment of the invention, before the sealing process, the diameter D_c of the cover (not shown in Fig. 2) has to fulfill the following inequality: $D_V < D_c < D_A$.

Referring to **Fig. 3**, a cross-sectional view of the vessel body portion before a sealing process is illustrated, according to yet another embodiment of the invention. According to this embodiment, in order to fix the cover portion within the vessel body portion, the vessel body portion has an undulated zone B near the open end of the vessel body portion. The diameter D_B of the vessel body portion at the undulated zone A has a value smaller than the diameter D_V at the remaining portion of the vessel. According to this embodiment of the invention, before the sealing process, the diameter D_c of the cover (not shown in Fig. 2) has to fulfill the following inequality: $D_B < D_c < D_V$.

Fig. 4 illustrates a cross-sectional view of the vessel of Fig. 1 surrounded by an induction coil 3 around the open end 11 of the vessel body portion 1 and over the edge 13 of the cover portion 2. Preferably, the open end 11 of the vessel body portion 1 is placed into a working zone (33 in Fig. 5) of the coil 3 at a distance of about 1-3 mm from an inner edge 32 of the coil 3.

Fig. 5 illustrates an example of the working induction coil 3, according to the invention. According to this example, the working induction coil 3 includes a one turn coil 32 with canals 4 made into coil's body 30. The canals 4 communicate to each other and to two openings 6 and 7 provided for the input and output of cooling liquid, e.g. water. In order to avoid the leakage of the cooling liquid, three additional openings (created in the coil's body 30 in order to form the canals 4) are

closed by plugs 5. The openings 6 and 7 are connected to a water pump (not shown) and a radiator (not shown) configured for cooling the cooling liquid.

According to one embodiment of the invention, the one turn coil 32 is connected with a battery of capacitors (not shown) through a pulse transformer (not shown).

According to another example, the working induction coil is a multi-turn coil (not shown) equipped with a field-shaper (not shown). In this case the multi-turn coil is connected to the capacitor battery directly. According to this example, the field-shaper has canals (not shown) connected to the water pump and the radiator.

The process of sealing the vessel 10 includes energizing the coil to generate the magnetic pulse force for collapsing the end of the vessel body portion around the cover portion. The magnet pulse must have such power that the end of the vessel body portion over its movement through the annular gap 12 could attain a velocity sufficient for the magnetic pulse force to weld the vessel body portion and the cover portion along the edge to each other.

According to the further embodiment of the invention (shown in Fig. 6), an insulated cylinder 8 is put on the vessel body 1 for better holding the vessel body in the working zone of the induction coil 3. Preferably, the inner diameter of the insulated cylinder 8 is equal to the outer diameter of the vessel body portion 1 placed under the cylinder 8.

According to one example, the vessel body portion can be driven to the welding zone of the working induction coil by means of a pneumatic cylinder (not shown).

According to another example, the vessel body portion can be driven to the welding zone by means of a hydraulic cylinder (not shown).

As such, those skilled in the art to which the present invention pertains, can appreciate that while the present invention has been described in terms of preferred embodiments, the concept upon which this disclosure is based may

readily be utilized as a basis for the designing of other structures, systems and processes for carrying out the several purposes of the present invention.

It is apparent that although the examples of the vessel of the present invention were shown for the vessel body portion having a circular cross-section, the sealing method of the present invention can be applied, *mutatis mutandis*, for the sealing of a vessel having an arbitrary cross-sectional shape.

Moreover, any reference to a specific implementation in terms of usage of the induction coil is shown by way of a non-limiting example.

Also, it is to be understood that the phraseology and terminology employed herein are for the purpose of description and should not be regarded as limiting.

It is important, therefore, that the scope of the invention is not construed as being limited by the illustrative embodiments set forth herein. Other variations are possible within the scope of the present invention as defined in the appended claims and their equivalents.

CLAIMS:

1. A method of sealing a vessel comprising:

- providing a vessel body portion having an open end;
- providing a cover portion;
- placing the cover portion into said open end of the vessel portion so that an annular gap is provided between said vessel body portion and an edge of said cover portion;
- providing an induction coil around said open end of said vessel body portion and over the edge of the cover portion; and
- energizing the coil to generate the magnetic pulse force for collapsing the end of the vessel body portion around the cover portion at a velocity sufficient for said magnetic pulse force to weld said vessel body portion and the cover portion along the edge to each other.

2. An apparatus for sealing a vessel comprising an induction coil configured for surrounding an open end of a vessel body portion, where said vessel body portion holds a cover portion being placed into said open end of the vessel body portion so that an annular gap is provided between said vessel body portion and the cover portion.

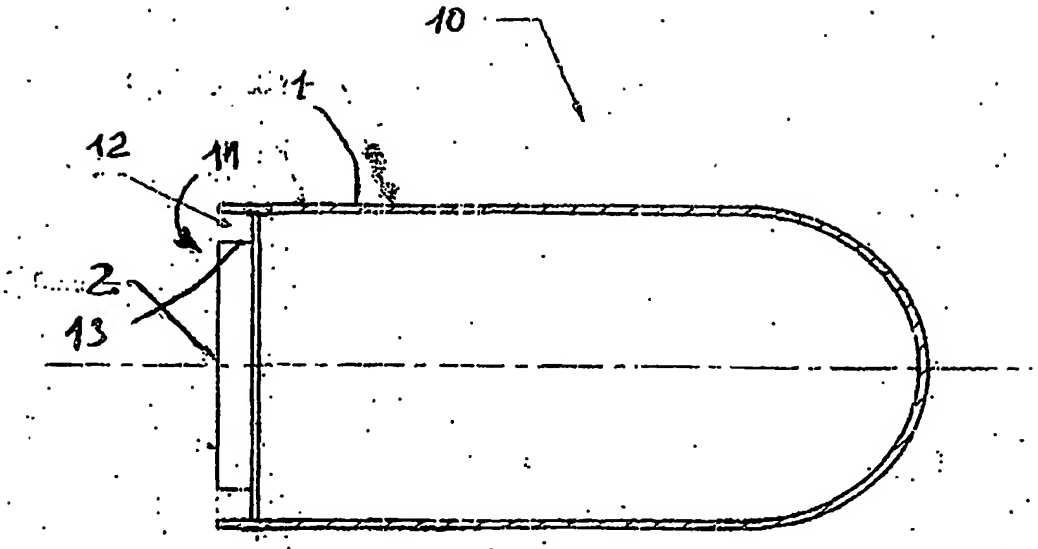

Fig. 1

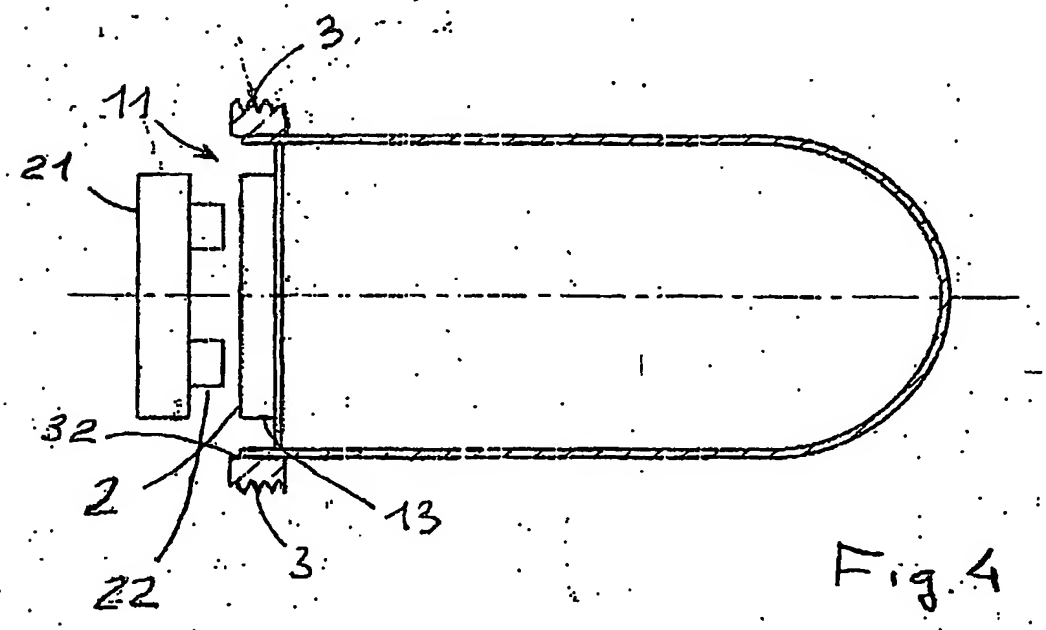

Fig. 4

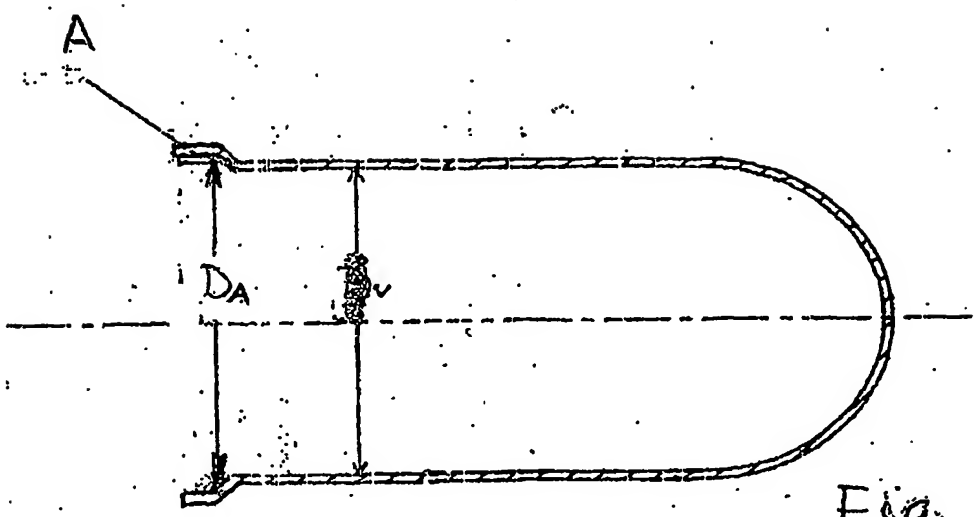

Fig. 2

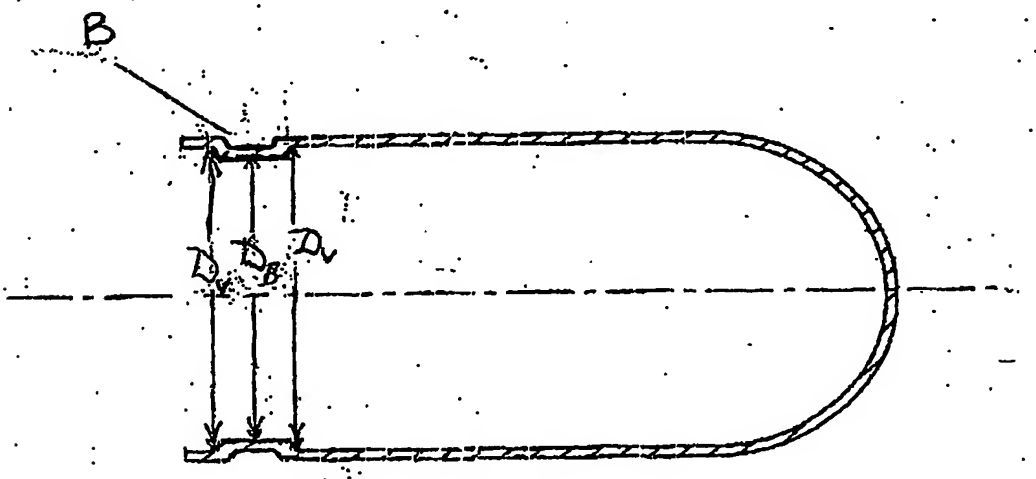

Fig. 3

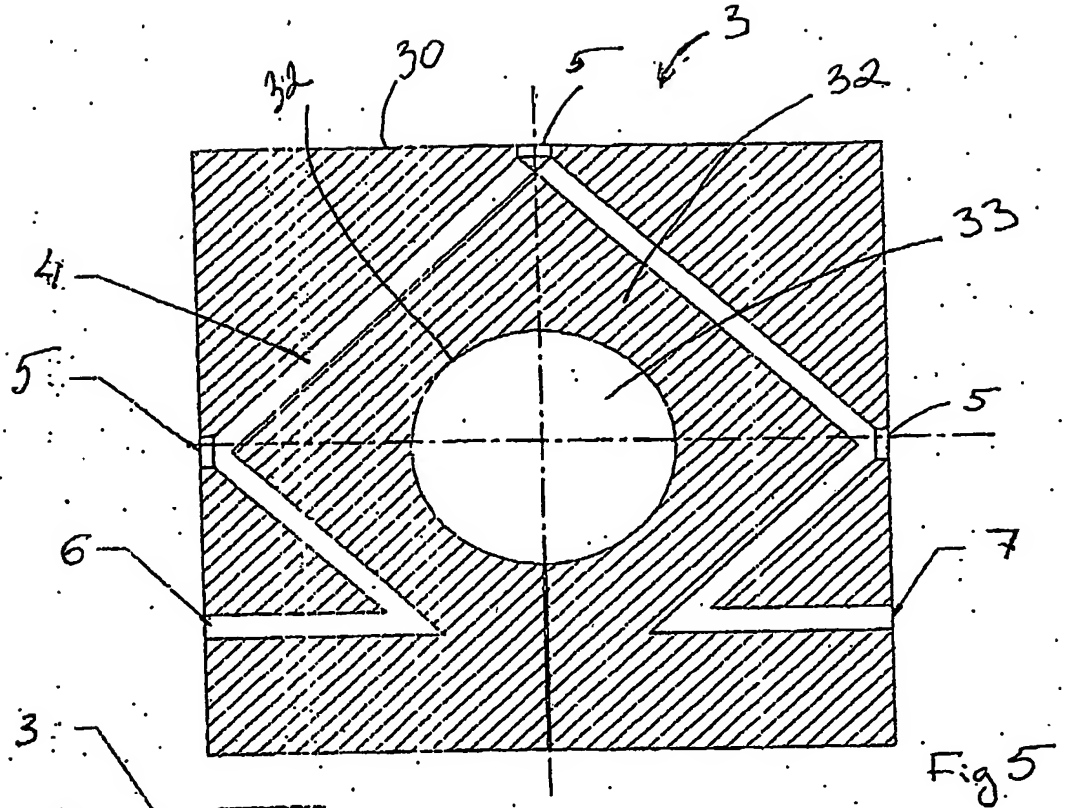

Fig 5

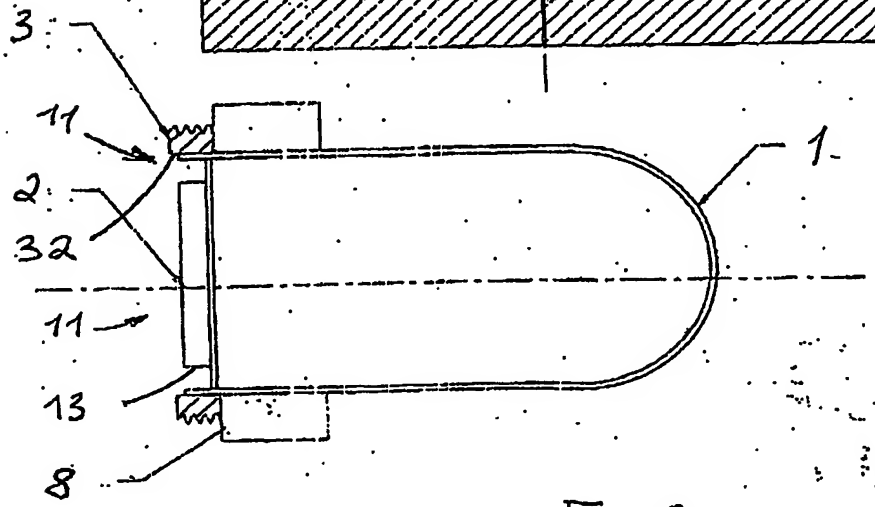

Fig 6